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Beneficent Blades

A waving and seemingly endless sea of grass unfolded before the first westward-bound settlers when they forded the Wabash River. The vast grassland which awed them forms a triangular peninsula whose other points stretch away into Texas and Saskatchewan. In those days it was the ancient domain of the Indian. Life of the various tribes revolved around the productivity of grass and the countless buffalo it sustained.

Farming and ranching long ago altered our grasslands so that only a few primeval remnants are now preserved. But while the character of the great North American grassland has been drastically changed, grass itself endures in our lives.

For example, grass is a proven ally in many battles for conservation. Grass both protects and restores. Its sheltering blades and network of roots mock at erosion—catching the pelting rainfall and leading it safely underground. When landscapes are abused—whether by erosion, stripmining, overcropping, or construction—it is grass that we turn to for healing and renewal.

Grass also helps make beef. Our western ranges are a major resource, even in this day of mechanized feedlots. Most feedlots buy their feeders from ranchers who run cow-calf operations, enterprises based on grass. Indeed, grass and hay account for about 70 percent of the nutrients that beef cattle consume over their lifetimes.

Grass serves us in countless other ways. To cite only a few: it mantles playgrounds, parks, and golf courses. Its green lushness on lawns provide balm for tired eyes and frayed nerves. It acts as a living filter for purifying sewage. It helps recharge the biosphere with life-sustaining oxygen.

Although grass is the most numerous member of the plant kingdom, some species have to be reshaped to meet changing needs. ARS scientists are involved in this effort. Over the years they have introduced and improved grasses that benefit farmer, rancher, and townsman. A major effort of today's research is the transfer of desirable genetic characteristics from one species or genera to another by exploiting the varied and often complex reproductive mechanism of grasses. Another important line of work is identifying the substances which render some species unpalatable to livestock.

The gift of grass is ours to use and cherish. Those who learn to live with it and manage it wisely will have learned much about the harmony that can exist betwen man and land.

—*R.P.K.*

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COVER: Dr. Marston employs a vacuum to collect insects from individual rows or even parts of rows. Correlation of insect population data with such data as row width, dates of planting and cultivation, and herbicide application helps researchers determine which applications and methods are most beneficial in growing soybeans (0975X1795–36). Article begins on page 6.

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Dr. Coria takes a blood sample from a heifer that has been injected with known adenoviruses isolated from calves suffering from weak calf syndrome. Researchers will use the antibodies this cow produces as a reference to identify similar adenoviruses in other sick animals (1275X2330–32).

a complex disease

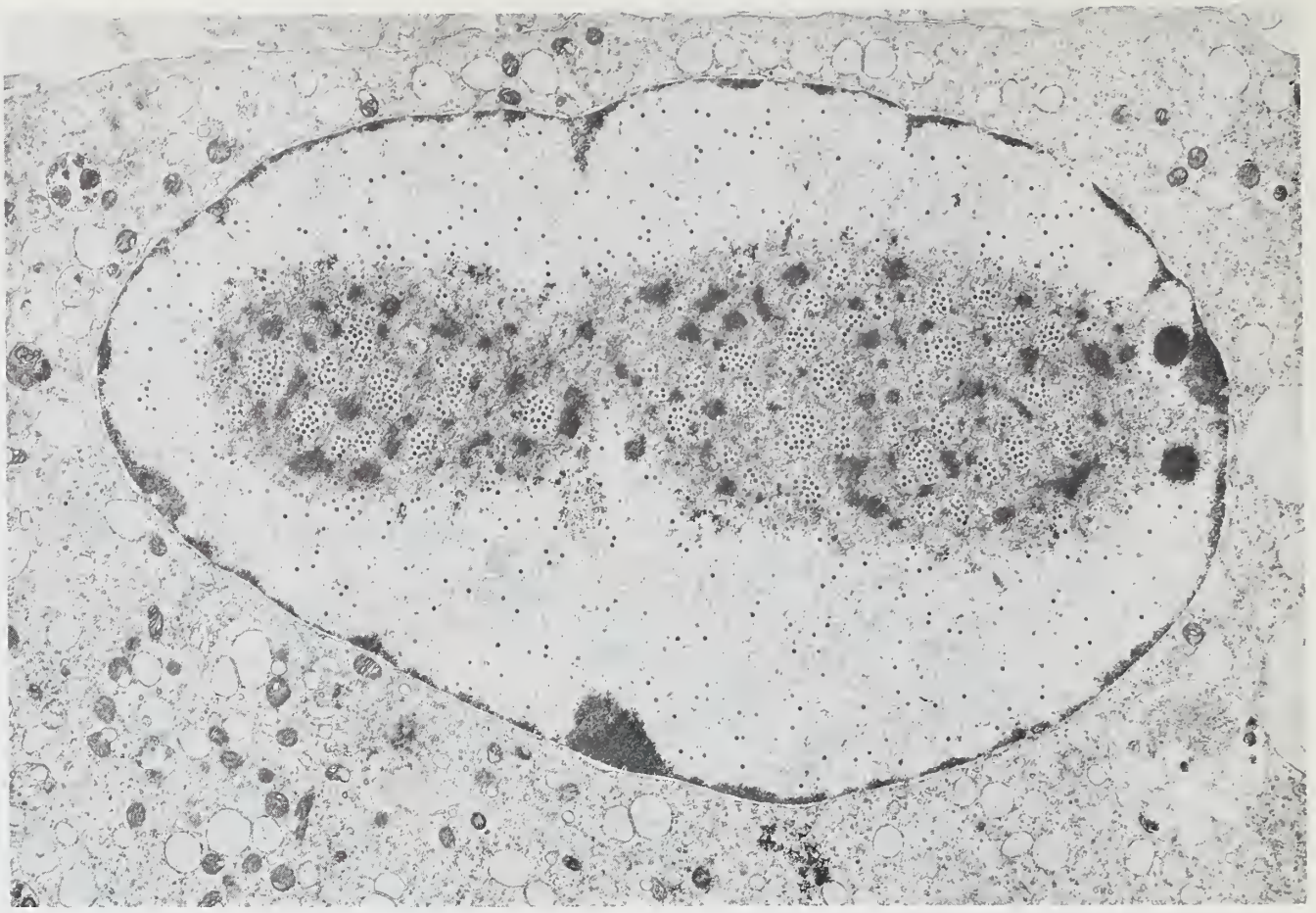
WEAK CALF SYNDROME, a disease of newborn calves, probably does not have a single cause. Rather, stresses produced by climate, nutrition, management, and two or more disease agents may be involved.

The disease, also termed polyarthritis, has been known for 6 to 10 years in eastern Idaho and southwestern Montana and probably occurs elsewhere, says ARS veterinary medical officer Arlan W. McClurkin. Sixty to 80 percent of the calves in a herd may be affected, with death losses of 6 to 15 percent.

Affected calves are usually weak at birth and often unable to get up and nurse without assistance. Their gait suggests sore leg joints, and researchers report that many calves develop diarrhea a few days after birth.

A team of scientists at the National Animal Disease Center, Ames, Iowa, in cooperation with veterinary scientists at the University of Idaho, Moscow, and Montana State University, Bozeman, has isolated two viruses from affected calves but has not established that they cause the disease.

Bovine viral diarrhea (BVD) virus is isolated most frequently, Dr. McClurkin says. Most herds where "weak calf syndrome" occurs are either not protected with a commercially available BVD vaccine or depend upon a single vaccination to produce lifetime immunity. BVD is widely disseminated in cattle. In some animals, it may persist in a form that is infective but not detected because the virus does not stimulate production of antibodies in them.



This microphotograph depicts bovine adenovirus growing in the nucleus of an infected cell (PN–4112).

The researchers also isolated a bovine adenovirus from Idaho calves affected with "weak calf syndrome." ARS microbiologist Manuel F. Coria, veterinary medical officer Randall C. Cutlip, physicist Alfred E. Ritchie, and Dr. McClurkin identified the adenovirus as type 5, not previously reported in the United States. It had been isolated in Hungary in calves showing clinical signs of pneumoenteritis.

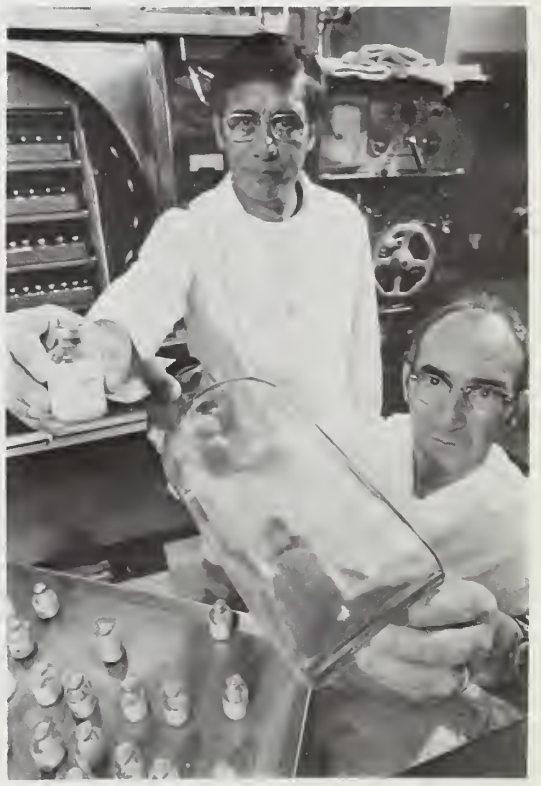
In a controlled laboratory environment, Dr. McClurkin and Dr. Coria found that this adenovirus produced a disease that was very mild and of short duration. They suggest that marginal protein intake by the cows and cold, wet weather probably influence the occurrence and severity of the disease under ranch conditions. Concurrent BVD infection and possibly other diseases are also involved.

Dr. McClurkin suggests that bovine adenovirus type 5 may be one of several stress factors that the newborn calves must adjust to and overcome in the first few weeks of life. Some combination of adverse environmental conditions and disease agents may together produce "weak calf syndrome."

Vaccinating heifers against both BVD and type 5 adenovirus before they are bred would, if successful, prevent infection of the calves before birth, Dr. McClurkin says. He has developed an experimental vaccine that has been promising in the laboratory and has produced no unfavorable reactions.

Results were inconclusive when the experimental vaccine was tried on about 15 percent of the replacement heifers in a dozen Idaho herds. Little sickness occurred in either these heifers or others in the herds that were not vaccinated, although there were severe outbreaks and calf losses in other herds.

NADC scientists are continuing their efforts to establish the cause of "weak calf syndrome" and design preventive measures.—*W.W.M.*



Dr. Coria and Dr. McClurkin with killed BVD vaccine before (right) and after freeze drying. Freeze drying removes water and improves the keeping quality of the vaccine (1275X2329–16).

Toward 1000-pound weaner calves

RESEARCH by ARS scientists has achieved forage-fed, "milk-fat" 700-pound weaner calves in the semi-arid Southern Plains. The scientists consider the achievement a springboard to producing 1,000 pound forage-fed weaner calves in the near future—possibly as early as 1980.

ARS agronomists Chester L. Dewald and E. H. (Pat) McIlvain working at the U.S. Southern Great Plains Field Station at Woodward, Okla., during the first 3 years of the study successfully and profitably raised weaner calves 200 to 250 pounds heavier than the regional average on a combination of native range and farmed forage.

Combining near-optimum cattle and forage management practices with complementary proportions of native range and farmed forage resulted in calves with a dramatic increase in weaning weight. The first year, when the heifers were bred at 14 months of age, average daily weight gain for their calves was 1.92 pounds and average weaning weight was 573 pounds. During the next 2 years average daily weight gain for calves was 2.25 and 2.38 pounds, and average weaning weight was 700 and 726 pounds.

Development of 1,000-pound, forage-fed weaner calves would bypass much of the need for feed-lot finishing. Calves would be ready for slaughter at weaning. They should be fat enough to grade choice and the meat should be well marbled, juicy, and tender.

The research is continuing because the results, although only preliminary, indicate this may be one answer to the urgent need for improved forage-beef production systems to insure:

- A dependable supply of high-quality, grass-fat beef;
- Lower beef production costs;
- Conservation of energy, moisture, and soil fertility;
- Availability of adequate grain for human nutrition; and
- More efficient use of existing range and pasturelands.

The 700-pound weaners were produced on 11 acres of native range and 1 acre of farmed forage per cow-calf pair. The crossbred cattle used were "Angford" or black baldy cows (½ Angus and ½ Hereford), Brangus bulls (⅝ Angus and ⅜ Brahma), and three-way cross "Brangford" calves (9/16 Angus, 4/16 Hereford, and 3/16 Brahma). There are currently 60 cows in the herd and the scientists plan to increase numbers to 90 next year.

Cows are rotationally grazed on rye and wheat during the flushing period (preparation for estrus) November 1 to 30, and for as long as the rye-wheat forage lasts during the 70-day breeding season, December 1 to February 8. Cows are otherwise moderately grazed on native range except when more farmed forage is produced than the calves can consume. Actually, cows spend much time on rye and wheat during each March, April, and May.

During periods when cows are on winter-dormant grass only, they are fed daily rations of 1.5 to 2.0 pounds of oilseed cake containing 41 percent protein and 1.5 to 2.0 pounds of cracked grain sorghum per head. Steer calves are implanted with diethylstilbestrol and heifers with zeranol, a chemical that enhances the growth of cattle.

Calving dates averaged October 12 the first year, October 9 the second year, and September 21 the third year of the study. All calves were given full access to wheat or rye or both from November 1 through May 30, and to pearl millet from June to weaning in early August.

The range management program included moderate use of native range, except for very light use in April and May, and again after weaning in August; brush and weed control; proper livestock distribution; and, most important, the complementary use of native range with a minimum acreage of high-quality farmed forage.

Proper timing of all farming and cattle operations has proved essential. Productive varieties of rye and wheat are planted in late August and September, fertilized at the rate of 30 pounds of actual nitrogen per acre before planting and again in February, and sprayed as needed to control insects and weeds. Hybrid pearl millet, one-fourth acre per calf, is planted in May following rye without additional fertilizer.

In an effort to achieve 1,000-pound weaner calves in the next few years, efforts are being made to further improve management practices. These efforts include refinement in timing the practices, the use of legumes, other superior forages, higher performance cattle, new range improvement practices, environment modification, supplemental and drougth feeding, and effective use of growth-promoting agents for both forage and cattle.—*V. R. B.*

Streamlining soybean

MIDWEST GROWERS who are bewildered by a conflicting assortment of ideas on growing soybeans most profitably will find sound bases for combining management techniques from a 5-year study on soybean production systems.

Soybean researchers of ARS and the Missouri Agricultural Experiment Station, Columbia, combining their talents, will soon embark on the second year of the uniquely designed project. Many scientific disciplines are brought to bear to gain basic information about Midwest soybean culture.

"On one level of research, which we call level I, some 14 scientists are working together to find relationships between management practices that farmers use currently and production efficiency," says ARS agricultural engineer Maurice R. Gebhardt who coordinates the study alongside plant physiologist David R. Johnson of the University of Missouri. On levels II and III, the scientists work in small groups and individually, fine-tuning the research to increase their understanding of basic principles that may be applied in future agricultural technology.

For the level I study primarily, ARS leased a 100-acre farm and laid out plots that measure 40 by 150 feet. "The plots are large enough to farm with 4-row equipment, yet small enough for taking detailed measurements," says Dr. Gebhardt.

Growing soybeans in rotation with corn, the scientists are comparing two planting dates, two seedbed preparations, two types of herbicides, and two row widths in all possible combinations. They are also evaluating continuous soybeans and weed control by cultivations on other plots with two planting dates. "In all, we're studying 20 different soybean production systems," says Dr. Gebhardt.

In each of the production systems the researchers monitor plant diseases, insect and weed populations, soil moisture, and lodging, nutrient uptake, and moisture stress in soybean plants.

One year's data for the level I study have been shared with farmers and others who have visited the plots and wish to make their own tentative interpretations, says Dr. Gebhardt.

Interpretations of the data will not be made by scientists until the end of the 5-year study when all of the seasonal variations can be taken into account.

In level II studies, a team of researchers is ascertaining influences upon soil moisture near roots of soybeans planted in 15- and 30-inch rows. On plots apart from, but similar to those used in level I studies, another team is measuring water runoff, erosion, and nutrient losses from no-till and conventional seedbeds.

In another field study, scientists are evaluating directed herbicide applications as a means to reduce harvesting losses by raising soybeans' podding height and control weeds in the same operation.

Still other level II studies are being focused on relationships between plant diseases and insect populations, and also between plant diseases and cultural practices.

On level III, individual scientists' studies include those on the competitiveness of soybean genotypes that are planted together, effects of prematurity stresses of soybeans on seed quality and shattering, restricted root growth in claypan soils, and sod planting of soybeans for seed and forage.—*G.B.H.*

production systems

One method of determining insect populations is to employ soil insect traps. When attracted by light, the insects move from the soil up into the conical trapping device. Dr. Marston prepares such a trap for field use (0975X1789–16A).

Above: To prevent root damage or alteration to the root system, University of Missouri research technicians Donald G. Purdy and James S. Beger exercise great care washing sod from the roots (0975X1789–3A). Below: The root systems are evaluated for total root growth and distribution (0975X1795–11).

The 100-acre plot on which these production management studies are conducted is large enough to permit use of conventional farm equipment, but small enough for precise measurements (0975X1797–9A).

The white fly is one of the insect populations under study. It is a common soybean pest usually found on velvet leaf weed near bean fields. The white fly's most important function is as a source of food for beneficial predators (0975X1793–22).

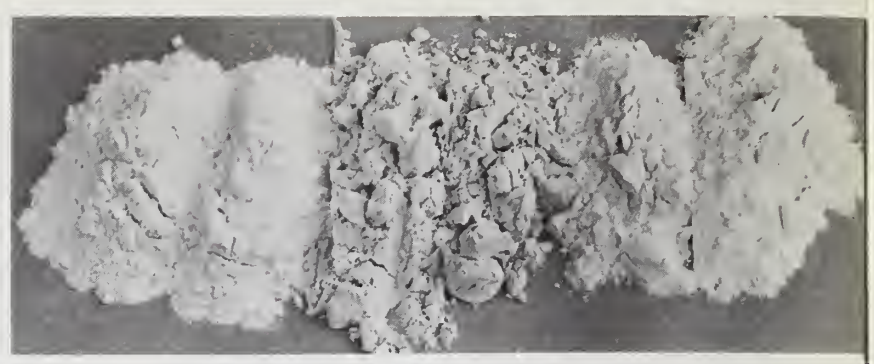
Dr. Marston and research assistant Mike K. Hennessey change the collection bag after completing a sample run (0975X1793–4).

University of Missouri plant pathologists join with ARS researchers to evaluate the results of field tests. Dr. Gerald E. Short prepares root samples for plating (left), while Dr. Tom D. Wyllie plates and mark samples. The scientists are trying to determine the number of disease organisms—in this case charcoal rot—present in the roots (0975X1792–12).

Does the production system under evaluation cause stress in plants? One way to tell is the measurement of leaf surface resistance with a stomata diffusion porometer. This instrument determines whether or not the leaf stomata are open or closed which, in turn, determines water movement into the leaves (0975X1792–8).

Right: *Flour from bran and head shorts and from tail shorts, center left and center right in photo, is mixed with straight grade flour, left and right. This mixture is used in making extended flour, second from left and right (1175X2281–5).*

Lower Right: *To the untrained eye, the differences between products baked with straight grade flour and extended flour are imperceptible. Baker Robert D. Crawford shows Kaiser rolls and bread that were baked with the two types of flour (1175X2281–21).*



5 percent more

FIVE PERCENT more flour can be ground from each bushel of wheat by an extended milling procedure, and the nutritional value of the flour is also improved.

With this procedure, explains ARS food technologist William C. Shuey, a mill of 5,000-hundredweight daily capacity could produce enough flour for about 51,000 more people each year from the same amount of wheat.

Extended extraction in the milling process thus increases the ability to meet world food needs without expanding wheat production. The procedure, so far tested only with hard red spring wheat, may have equal application in milling flour from other types of wheat.

Flour output is increased 5 percent by regrinding the byproducts of milling straight-grade flour. These millfeed products—bran and shorts—usually are incorporated into animal feeds.

The extended extraction flour contains more than double the amount of vitamin B_1 in straight-grade flour, Dr. Shuey says. Its nutritional value is further improved by an increase of about 8 percent in the essential amino acid lysine and added minerals. These nutritionally important components are recovered from the part of the wheat kernel immediately under the seedcoat.

The procedure has advantages for the miller, whose objective is to produce the most salable flour possible from the

Above: *Physical science technician Robert D. Maneval pours tail shorts, an extraction by-product normally used for livestock feed, into a pin mill for advanced extraction. Three resulting flours are mixed with strtight grade flour to make extended flour (1175X2277–36).* ***Upper Right:*** *After milling, Mr. Maneval checks under the inspection plate on the pilot flour mill to insure an accurate sample and, equally important, to keep the equipment clean (1175X2280–16).* ***Lower Right:*** *Mr. Maneval collects samples during the milling process. Later, researchers will determine the ash content and the quality of the flour (1175X2279–19).*

wheat he buys. And no changes are needed in mill settings or procedures for regular flour production. Extended extraction flour, however, has a slightly darker color and higher flour ash (mineral) content than is currently considered optimum. So present quality standards for flour would need to be modified, Dr. Shuey points out.

Dr. Shuey, technician Robert D. Maneval, and food technologist Joel W. Dick developed the extended extraction procedure in cooperation with the North Dakota Agricultural Experiment Station, Fargo.

The procedure requires three additional steps after milling straight-grade flour the usual way. The bran and head shorts are reground together in an impact mill, and flour is recovered by shifting. The tail shorts are reground twice to extract flour in another type of impact mill of greater grinding severity.

The extended extraction flour is a blend of the original straight-grade flour and three flours obtained by regrinding the millfeed products.

The hard red spring wheats used in the test were selected to provide a wide range of regular flour extraction—69.7 to 77.9 percent in a preliminary test. They included the Prodax, Kitt, and Era semidwarf wheats and Chris and Waldron conventional-height wheats grown at six locations in Minnesota, North Dakota, and Montana.

All varieties responded essentially the same to extended mill flow, Dr. Shuey says. The average increase in flour output was 5.6 percent, with total extraction ranging from 77.4 to 81.6 percent.

Varietal differences, rather than production environment or kernel characteristics, appeared to be responsible for variations in extraction percentage. Flour yield was almost identical from Era samples grown in North Dakota and Minnesota.

British millers were prohibited by law from producing flour of less than 85 percent extraction as a wheat conservation measure during World War II, but flour quality was lowered. With equipment and techniques now available, Dr. Shuey believes that 80 percent extraction of acceptable flour can now be considered practical.—*W.W.M.*

Frontal view, greatly magnified, of Menacanthus stramineus. *This is one of three species of chicken lice commonly found in the United States. A fungus,* Trenomyces histophtorus, *may someday provide effective biological control of these debilitating pests of poultry (PN–4111).*

Fungus vs. Louse

AN ECCENTRIC FUNGUS may be on its way to delousing the chicken industry.

The attachment of its fellow fungi (order Laboulbeniales) is only skin deep, but *Trenomyces histophtorus* sends its rhizomycelium deep into the body of its host, the chicken louse. This deep growth spreads and destroys vital body tissue, so debilitating the louse that it should be unable to withstand very low-level dosages of insecticide. The parasite is host specific for chicken lice and could make for a highly effective biological control of this pest.

Such a control would have important economic as well as environmental significance. Recent related studies have shown the economic importance of maintaining good control of the chicken louse. It is not the harmless nuisance it was thought to be. The insect not only feeds on feathers, but blood as well. Moreover, it chews around the base of feathers making wounds that often become infected with bacteria which cause even further damage. The studies showed that caged layers heavily infested with lice ate less, lost weight, and produced substantially

fewer eggs than did lice-free birds. They also became very excitable and showed a marked decrease in activity.

ARS entomologists Shirlee Meola and Joyce DeVaney of the Veterinary Toxicology and Entomology Research Laboratory, College Station, Texas, did research on three species of chicken lice commonly found in the United States to determine how vulnerable they were to the fungus. The lice were raised on White Leghorn chickens, infected with the fungus, removed, and examined with an electron microscope.

In the test, all three species of lice became infected as well as both sexes of each species. The fungus attaches to all parts of the insect's body, but mostly to the abdomen.

Other members of Laboulbeniales do not penetrate the cubicle of the host and thus cause little damage. *Trenomyces histophtorus*, however, develops a rhizoid that penetrates the cuticle of the louse and expands into a large bulbus organ which sends out secondary bulbs. From these bulbs, hyphae (rootlike growths) spread throughout the insect's body. The body tissue, both muscle and fat, then deteriorates as it is replaced by the fungus. Since the louse depends on these tissues for nutrition, movement, and metabolism, the invasion by the parasite kills many of them.

The scientists expect further research to show that the remaining lice could be controlled by small, normally sublethal, dosages of insecticide, thus reducing the amount of chemicals required.—*B.D.C.*

Controversial Vitamin

Lack of vitamin C in an otherwise adequate diet will eventually result in physiological disaster, demonstrating the close relationship this vitamin has to other nutrients as they function in the body.

For example, in studies of vitamin C (ascorbic acid), Indian scientists found important metabolic interrelationships among this vitamin, iron, vitamin E, and protein. The Indians studied the nutritional status of guinea pigs fed whole grain cereal diets as a model for determining the effects of subclinical scurvy in humans.

Research chemist Orville A. Levander, ARS-cooperating scientist, Beltsville, Md., said this project suggests that peoples whose diet consists largely of cereal grains have an increased need for vitamin C.

The Indian scientists found that excessive iron in a cereal grain diet inhibits the metabolism of vitamin C and, in the absence of protein fortification, has a toxic effect. Moreover, such protein deficient diets provide evidence of lipid peroxidation—destruction of the membrane of red blood corpuscles in the absence of antioxidants such as vitamin E. Antioxidants unite with oxygen to prevent the formation of such destructive agents as lipid peroxide.

In the Indian experiments, vitamin E partially increased the metabolic use of iron by dissipating the excess iron stored in tissues. However, the maximum utilization of iron—increased hemoglobin and serum iron levels—was achieved when doses of both vitamins C and E were also administered.

Dr. I. B. Chatterjee, principal investigator, said the failure of the guinea pig and man to synthesize ascorbic acid is due to an evolutionary loss of the necessary enzyme to convert L-gulonolactone—a carbohydrate derived from glucose—to vitamin C. Taking into account the nature of the evolutionary process, some scientists speculate that for optimum health the daily intake of ascorbic acid for an adult man should be much higher than the Recommended Dietary Allowance established by the U.S. National Research Council.

Dr. Chatterjee said, "In experiments with guinea pigs, we did not get any extra beneficial effects of large doses of ascorbic acid on growth and maintenance of the animals fed a fortified wheat diet. Instead, when guinea pigs were fed a low protein, high cereal diet, a daily intake of 30 milligrams of ascorbic acid per 100 grams of body weight was toxic, as evidenced by inhibition of growth and early mortality."

Dr. Levander said, however, that this research does indicate that vitamin C may have a beneficial anti-histamine-like effect. "Whether it will eventually be possible to moderate certain conditions of bodily stress by the intake of this nutrient cannot be said at this stage of the work. But initial findings are promising enough to justify additional support for these efforts."

The Indian research was conducted under the provisions of Public Law 480 at the University College of Science, Calcutta.—*M.C.G.*

Lack of vitamin C causes scurvy, which is characterized by swollen joints, bleeding gums, loose teeth, bone lesions, anemia, emaciation, and death. Such extreme deficiencies are not common today. But subclinical scurvy is known and may cause various physiological disorders.

Singeing on the range

CACTUS is a highly nutritious feed for cattle—provided the spines are singed off first. Plains pricklypear cactus, a spiney weed that cattle rarely eat, may increase beef production of cattle wintering on the western, more arid parts of the Great Plains rangelands. This area extends roughly from Montana and North Dakota to Texas and New Mexico.

Ranchers sometimes singe cactus to furnish emergency feed for cattle during a drought. With practical methods and machines for harvesting and singeing the cactus, it might be used on a regular basis for supplementing cattle on winter ranges. This would also provide effective control of a nuisance plant.

In studies at the Central Plains Experimental Range near Nunn, Colo., ARS scientists found that heifers fed singed pricklypear cactus (*Opuntia polyacantha*) as a supplement to hay gained an average of 1½ pounds daily. Heifers fed only the amount of hay that would furnish the nutrition ordinarily received on a winter range gained less than 1 pound per day.

In an 84-day trial, 12 yearling heifers, averaging 550 pounds, were fed a daily basal ration of grass-hay pellets at 2 percent of body weight plus about ¾ pound of cottonseed meal. Half of the heifers in this group also received as much singed pricklypear cactus as they wanted. In addition to the basal ration, they consumed a daily average of 5.6 pounds dry weight of fresh cactus. At the end of the trial, cattle on the hay diet had gained only 72 pounds while those on the cactus-hay diet had gained 124 pounds.

Digestion trials show that cactus was more readily and completely digested than the hay diet. The crude protein and digestible protein varied little between the two diets.

The scientists gathered the cactus for livestock feeding by handraking it from the range. They then placed it in an old water tank and used a propane torch to singe off the spines.

Because preliminary tests showed the cactus to have high energy content and relatively high digestibility, the scientists are now conducting further research to find more practical methods and machines for harvesting, singeing, and feeding the cactus as a winter supplement.

ARS range scientists Marvin C. Shoop and Donald N. Hyder and Colorado State University graduate student Eddie Alford began this research in 1974.—*D.H.S.*

Breed drylot ewes later

LATE-SEASON BREEDING may help overcome the adverse effects of drylot management on the ovulation rates of ewes. Research on the effects of pasture versus drylot management on ewe ovulation indicates that lower ovulation rates in drylot ewes cause lower lamb production.

Year-round confinement of the ewe flock to a drylot is relatively new to the U.S. sheep industry. In previous performance studies, both birth and weaning weights of drylot lambs exceeded weights of lambs born to pasture ewes. However, significantly fewer lambs were born per ewe in drylots than on irrigated pastures, during a 10-year period of observation by ARS.

To determine whether this lower production might be explained by lower ovulation rates, ARS and the University of Idaho, Moscow, initiated a study. It was conducted by animal physiologist Clarence V. Hulet and animal scientists Donald A. Price of the U.S. Sheep Experiment Station, Dubois, Idaho, and J. J. Dahmen and Dale O. Everson of the University of Idaho.

The researchers made random assignments of 172 Panama ewes which had been managed on either drylots or in pastures during a part of the 10-year observation period; half the ewes remained in their original management program and half were switched to the opposite program. All ewes received the same harvested feeds during the winter.

The researchers then studied the effects that their management programs had on the ewes' ovulation rates near the beginning of the breeding season, and about 2 weeks later in the season at two consecutive heat periods.

Once again lamb production was consistently lowest among drylot ewes; next lowest among pasture ewes switched to drylot management; next to highest among drylot ewes switched to pasture; and highest among the pasture-managed ewes.

Analysis of the ovulation data clearly indicated that lower lamb production among drylot ewes and ewes switched from pasture to drylot resulted from consistently lower ovulation rates.

Differences in ovulation rates, however, were much smaller at the second observation each year than at the first. These research results suggest that a drylot environment may cause a later breeding season, a situation sheepmen could easily adapt to.—*L.C.Y.*

Transmission of bovine leukemia

INDIRECT experimental evidence suggents that bovine leukemia, a disease of cattle, may be transmissible to man.

The evidence comes from studies in which eight adult chimpanzees developed specific antibodies after inoculation with bovine leukemia virus. Production of antibodies is a response by the body's immune system. This response indicates that persistent infections were established, says ARS veterinary medical officer Martin J. Van Der Maaten.

Bovine leukemia occurs more often in dairy than in beef cattle, usually in widely scattered herds. The possibility that man might be susceptible to the bovine form of leukemia has long been recognized, Dr. Van Der Maaten says, emphasizing that bovine leukemia has not been reported in man. Studies on susceptibility of primates became possible after the virus causing the disease was identified (AGR. RES., Dec. 1974, p. 12).

Dr. Van Der Maaten and ARS veterinary medical officer Janice M. Miller of the National Animal Disease Center, Ames, Iowa, participated in the study along with medical officers Kelley J. Donham, Michael J. Rubino, and Loren A. Will of the Institute of Agricultural Medicine, University of Iowa, Oakdale.

The studies so far have not furnished absolute proof of bovine leukemia infection in the chimpanzees. Researchers have not demonstrated that the virus is replicating in, or can be recovered from, the inoculated chimpanzees. Experience with experimentally infected calves and sheep indicates that virus isolation may not be possible until much later in the course of infection, Dr. Van Der Maaten says.

Neither, in a concurrent study, have the researchers detected antibodies to bovine leukemia virus in close to 1,300 human blood samples. These samples were from leukemia patients, families with high incidence of cancer, and patients with other kinds of tumors or ill with other diseases.

In the studies with chimpanzees, Dr. Van Der Maaten and associates first determined that they did not have preexisting antibodies to bovine leukemia virus antigens. Then 8 of the 10 chimpanzees, 2 to 8 years of age, were inoculated with the virus. All eight developed antibodies 6 to 15 weeks after inoculation, and the antibodies have persisted for 10 months.—*W.W.M.*

Better than malathion

TWO experimental insecticides recently tested at the Stored-Product Insects Research and Development Laboratory, Savannah, Ga., proved more toxic than malathion to six economically important insects that infest foodstuffs in marketing channels.

The affected insects constitute a continuing major problem in food warehouses and are fast becoming resistant to malathion. This increasing resistance to malathion only serves to heighten the insect problem in storage facilities.

The two chemicals are known as pirimiphos-methyl and Bay SRA 7660. The insects are the cigarette beetle, *Lasioderma serricorne* (F.); the red flour bettle, *Tribolium castaneum* (Herbst); the confused flour beetle, *T. confusum* Jacquelin duVal; the black carpet beetle, *Attagenus piceus* (Oliver); the Indian meal moth, *Plodia interpunctella* (Hubner); and the almond moth, *Cadra cautella* (Walker).

Both chemicals were applied topically to the test insects and the toxicity of pirimiphos-methyl to both adult and larval stages of the insects indicates that it may be a broad-spectrum insecticide comparable to or even more effective than malathion.

In the tests, conducted by biological technician Lehman L. McDonald and entomologist H. B. Gillenwater, pirimiphos-methyl proved more toxic than malathion to each species of test insect and was more toxic to the adult insects than Bay SRA 7660. Bay SRA 7660 was more toxic than either pirimiphos-methyl or malathion to the larval stages of the test insects and was more toxic than malathion to adult cigarette beetles; however, it was less toxic than malathion to both species of flour beetle.

The experimental insecticides are desirable for use around stored foodstuffs for a reason beyond their insecticidal properties: their apparent low toxicity to warm-blooded animals. Earlier tests with rats showed the acute oral dose to be 2,050 mg/kg for pirimiphos-methyl and more than 2,500 mg/kg for Bay SRA 7660. By contrast, the acute oral dose of malathion in rats is 885 to 2,800 mg/kg of body weight.—*V.R.B.*

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A nutritional role for arsenic?

ARSENIC, long recognized as a poison, may serve an essential nutritional role. For the first time, strong evidence has been found that small amounts of arsenic may be essential for good health in rats.

At the Human Nutrition Laboratory, Grand Forks, N. Dak., ARS biochemist Forrest H. Nielsen observed abnormalities in laboratory rats that were deprived of arsenic in an experiment he conducted as a preliminary step toward studying a possible role of arsenic in human nutrition.

Dr. Nielsen fed pregnant rats a diet with as little arsenic as 30 parts per billion (ppb). Control rats received the same feed supplemented to increase the arsenic concentration to about 5 parts per million (ppm)—a 167-fold increase.

Offspring of arsenic-deprived rats had rough hair, slow growth rates, and dark-colored spleens that contained 50 percent more iron and were up to twice as large as spleens of the control rats.

To induce arsenic deficiencies, Dr. Nielsen formulated a diet from carefully selected and processed feeds. Ingredients included dried skim milk, acid-washed ground corn, and corn oil.

Most human foods such as fruits, vegetables, and cereals contain less than 0.5 ppm arsenic and rarely more than 1 ppm. Food products from animals generally contain less, except those of marine origin which contain about 2 to 8 ppm.

Other ARS studies have shown that arsenic residues do not accumulate excessively in plants or animals under normal circumstances.—*G.B.H.*

Keeping CO_2 in the greenhouse

IT's like throwing the baby out with the bath water.

In the wintertime the greenhouse industry—those commercial growers who produce vegetables and other crops under glass or plastic—fertilize the air with carbon dioxide (CO_2) to increase yields. During the summer, temperatures get so high that the houses have to be cooled. Conventional evaporative coolers, however, exhausted aid to the outside making CO_2 fertilization futile under these summertime conditions.

Now, however, ARS soil scientist Bruce A. Kimball has solved the problem by developing a "closed" evaporative cooling system for greenhouses.

In using his system, Dr. Kimball cools water in an aspen pad cooling tower outside the greenhouse, and pipes it to an aspen pad heat exchanger inside the house. Then he simply recirculates the air within the house through the inside heat exchanger. Little CO_2 is lost, and warm water from the heat exchanger is piped back to the cooling tower and recooled.

The system has the potential of cooling a greenhouse to 86° F when the outside air temperature is 110° F at 25 percent humidity, Dr. Kimball says.

Dr. Kimball conducted this research project at the U.S. Water Conservation Laboratory, Phoenix, Ariz.—*J.P.D.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.